

Carbon dioxide + Methane as Greenhouse

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.9 Chemistry of the Atmosphere
Sub-Topic	Carbon dioxide + Methane as Greenhouse
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 41 minutes

Score: /39

Percentage: /100

Grade Boundaries:

- M1.(a)** sediment / limestone formation from carbonates 1
- (b) short wavelength radiation 1
- passes through atmosphere to Earth's surface 1
- Earth's surface radiates different wavelengths 1
- which are absorbed by greenhouse gases to produce temperature increase
allow CH₄ H₂O or CO₂ 1
- (c) 13.8 %
allow values in the range 13.0 to 15.0 1
- (d) 15.08 (°C)
allow values in the range 15.05 – 15.10 1
- (e) correlation between CO₂ levels and temperature 1
- despite short-term variations of temperature 1
- supported by values from graph which show correlation

1

cannot determine causality from this data or possible causality as increasing use of fossil fuels since 1900 has caused accelerated temperature increase

1

[11]

M2.Level 3 (5–6 marks):

A full explanation is given that is coherent and logically structured, linking effect of increase in carbon dioxide to climate change and effects on biodiversity.

Level 2 (3–4 marks):

An attempt is made to link the effects of rising carbon dioxide levels to climate change and biodiversity. The logic may be inconsistent at times but builds towards a coherent explanation.

Level 1 (1–2 marks):

Discrete relevant points made. The logic may be unclear and attempts at reasoning may not be consistent.

0 marks:

No relevant content.

Indicative content

- rise in carbon dioxide increases atmospheric temperature / causes global warming
- global warming causes extreme weather patterns
- such as rise in sea levels
- increased or decreased rainfall
- frequency of storms / droughts
- rise in sea levels means habitats will change due to flooding
- rise in sea levels could increase salt in soil
- increased rainfall will increase water levels
- severity of storms / droughts could affect photosynthesis
- consequences of changes are loss of or damage to habitats
- which will affect animal and plant distributions
- by increasing migration or species dying off
- which decreases biodiversity

[6]

M3.(a) gravity (of moon and sun)

1

(b) any **two** from:

1 mark for statement, 1 mark for correctly linked reason

- tidal energy is renewable (1)
- so won't run out like fossil fuels (1)

or

- doesn't emit carbon dioxide
- so won't contribute to global warming / climate change

or

- doesn't emit oxides of sulfur or nitrogen
- so doesn't cause acid rain

or

- doesn't use fossil fuels
- so less impact on environment of extraction / transport

or

- doesn't produce particulates
- so less effect on health / environment

Max. 4

(c) coal consumption per year = $29.25 \times 1000 \times 6 \text{ million} = 175\,500\,000\,000 \text{ MJ}$

1

1 hectare of willow will produce $9 \times 13 \times 1000 = 117\,000 \text{ MJ per year}$

1

so need $175\,500\,000\,000 \div 117\,000 = 1\,500\,000 \text{ (hectares)}$

1

allow 1 500 000 with no working shown for 3 marks

(d) although has higher direct emissions than other fuels

1

it has much lower lifetime emissions

1

[10]

M4. any **four** from:

to gain 4 marks both pros and cons should be given

Arguments for biodiesel

max **three** from:

- sustainable / renewable
- (carbon neutral) absorbs CO₂ when growing / during photosynthesis
- burning biodiesel produces low amounts particulates / carbon monoxide
allow burning biodiesel produces little / low amount of global dimming
ignore sulfur dioxide
- can use waste vegetable oils / fats (from food industry) **or** can use waste plant material
- can be used to conserve crude oil (instead of / mixed with petroleum diesel)
- produced by a low energy / temperature process
accept produced by a low tech process
- biodegrades (easily)
ignore engine effects

Arguments against biodiesel

max **three** from:

- creates food shortages
accept price of food increases
- deforestation to plant more crops leads to loss of habitat / biodiversity **or** deforestation leads to a reduction in absorption of CO₂
allow burning trees increases CO₂
allow deforestation increases global warming
- burning biodiesel produces high amounts of nitrogen oxides
allow increases acid rain
- crops takes time to grow
allow crops can fail
- vast areas of land needed to grow crops

4

conclusion supported by the argument presented, which must give added value to the points for and against given above

1

[5]

- M5.** (a) (i) (thermal) decomposition
allow it breaks down
accept symbol equation or in words
allow reaction with SO₂ (to form CO₂)

1

- (ii) calcium carbonate / calcium oxide / limestone / quicklime / it reacts with sulfur dioxide / forms calcium sulfate
accept it neutralises sulfur dioxide / neutralisation
ignore references to sulfur
do not accept 'calcium reacts with...'

1

- (b) by incomplete / partial combustion (of the fuel)

1

insufficient oxygen / *air* (to burn fuel)
accept insufficient oxygen / air to burn fuel completely for 2 marks
if no other marks awarded
accept $C + CO_2 \rightarrow 2CO$ or
 $2C + O_2 \rightarrow 2CO$ or in words for 1 mark

1

- (c) (i) any **two** from:
- (CO₂) from the atmosphere
 - (CO₂) taken in millions of years ago **or** early (atmosphere)
allow thousands / billions
allow rocks formed millions of years ago
 - (CO₂) was used to form the shells / skeletons of marine organisms / fossil fuels

accept sedimentary rocks
allow used to form correct named fossil fuel
ignore limestone

2

(ii) any **one** from:

- (increases / enhances) global warming
allow greenhouse gas / effect
*do **not** accept ozone layer / acid rain / global dimming*
ignore consequences of global warming
- is additional carbon dioxide **or** not able to be absorbed by oceans / seas **or** used by (green) plants
- acidification of sea water

1

[7]